

Q1: Multiple Choice Questions

Circle the correct answer for each of the following:

(10 × 1 marks)

- ✓ i) The MAC protocol for Ethernet is _____.
a. HDLC
☒ b. CSMA/CD
c. CSMA/CA
d. DHCP
- ✓ ii) The maximum efficiency of Slotted ALOHA is _____.
a. 18%
b. 36%
☒ c. 37%
d. 95%
- ✓ iii) There is no Media Access Control in _____.
a. Ethernet
☒ b. PPP
c. Token ring
d. ATM
- ✓ iv) Ethernet's MAC protocol is _____.
a. CSMA
☒ b. CSMA/CD
c. CSMA/CA
d. Token Passing
- v) Link layer is implemented in an "adaptor" commonly known as
a. MAC
☒ b. NIC
c. CRC
d. CSMA
- ✓ vi) Frame Relay is a _____ Area Network technology
☒ a. Wide
b. Local
c. Metropolitan
d. Personal
- ✓ vii) TDMA belongs to the following class of protocols
☒ a. Channel Partitioning
b. Random Access
c. Taking-turns
d. Address Resolution

- ✓viii) When an entry is placed in the ARP table, the typical time-to-live (TTL) is _____
- a. 10 minutes
 - ☒ b. 20 minutes
 - c. 30 minutes
 - d. 40 minutes
- ✓ix) An ATM cell has a payload of these many bytes:
- a. 1480 bytes
 - ☒ b. 48 bytes
 - c. 56 bytes
 - d. 32 bytes
- ✓x) Size of preamble in an Ethernet frame is _____
- a. 7 bytes
 - ☒ b. 8 bytes
 - c. 9 bytes
 - d. 10 bytes

Q2: Answer the following questions. Show complete work to receive full credit

- a) The following data was received by the receiver: $M = 11000\ 11011\ 11100\ 10010$, with the checksum bits being 10110. Are there any errors in the received data?
- b) Using CRC, message $M = 1011001101$ is to be sent using the polynomial generator $x^4 + x^3 + 1$. Determine the data stream to be transmitted.

[a]

$$\begin{array}{r}
 11000 \\
 11011 \\
 \hline
 10011 \\
 10011 \\
 \hline
 00100 \\
 11100 \\
 \hline
 10000 \\
 10001 \\
 \hline
 10010 \\
 00011 \\
 \hline
 00100 \\
 10110 \\
 \hline
 10101
 \end{array}$$

Yes, there are errors because the result is not all 1's

5.5

[b]

$$\begin{array}{r}
 1101010000 \\
 11001 \\
 \hline
 011110 \\
 11001 \\
 \hline
 00011111 \\
 11001 \\
 \hline
 0011001 \\
 11001 \\
 \hline
 00000000
 \end{array}$$

the data that will be transmitted is 10110011010000

5.5

$$\begin{array}{r}
 1101010000 \\
 11001 \\
 \hline
 1011001 \\
 11001 \\
 \hline
 11001 \\
 11001 \\
 \hline
 11001 \\
 11001 \\
 \hline
 0000
 \end{array}$$

Q3: List seven services of the link layer and briefly define each one of them.

① Framing: It will encapsulate the data gram into a link layer frame before transmitting

② Error detection: In the receiving side, it should detect if there is an error in the frame that received or not.

③ Error correction: In the receiving side, it not should only detect the error but also it must correct the error

④ Flow control: because maybe the sender rate is more than the receiver rate or the opposite, so the link layer provide flow control to not throttle the receiver, so there will not be lossing of data

⑤ Link access: By the medium access protocol control (MAC) the link will be accessible for all the nodes, so ~~there will be no collisions~~ or ~~if there is any~~ the link will be controlled to reduce or make no collisions

~~Same thing~~
⑥ Multiple protocols: It will use multiple protocols at different mediums at the same time (it must able multiple protocols to operate over different speeds of mediums at the same time)

⑦ Multipoint links: it supports broadcast links

⑧ half and full duplex: half duplex in which the receiver and the sender can't transmit at the same time, but full duplex both sides can transmit at the same time

⑨ Reliable data delivery

8.5

Q4: Calculate the efficiency of the following:

- Pure ALOHA for $p = 0.5$ and $N = 70$
- Slotted ALOHA for $p = 0.5$ and $N = 70$
- CSMA/CD for $t_{\text{prop}} = 2$ msec and $t_{\text{trans}} = 6$ msec
- What do you observe with regard to the results of parts (a) and (b), and how would you justify the results?

$$\begin{aligned} \text{a) efficiency of Pure ALOHA} &= P(1-P)^{2(N-1)} \\ &= 0.5(1-0.5)^{2(70-1)} \\ &= 0.5(0.5)^{138} \\ &= 1.4349 \times 10^{-42} \end{aligned}$$

2.5

$$\begin{aligned} \text{b) efficiency of slotted ALOHA} &= NP(1-P)^{(N-1)} \\ &= (70)(0.5)[1-0.5]^{(70-1)} \\ &= (35)(1.6941 \times 10^{-21}) \\ &= 5.9294 \times 10^{-20} \end{aligned}$$

2.5

$$\begin{aligned} \text{c) efficiency of CSMA/CD} &= \frac{1}{1 + \frac{5t_{\text{prop}}}{t_{\text{trans}}}} = \frac{1}{1 + \frac{5(2 \times 10^{-3})}{6 \times 10^{-3}}} \\ &= \frac{1}{1 + 1.67} \\ &= 5.952 \times 10^{-3} \end{aligned}$$

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d) The efficiency of slotted ALOHA is more than the efficiency of ALOHA. *because the collisions in ALOHA is more than in slotted ALOHA*

In real the maximum efficiency of slotted ALOHA = $\frac{1}{2} = 0.37 = 37\%$

and the maximum efficiency of ALOHA = $\frac{1}{2S} = 0.18 = 18\%$

then, because of that I got an efficiency of slotted ALOHA twice than ALOHA

This is an observation, not a justification!

Q5: Answer ANY SEVEN of the following questions

- ✓a) What is the main difference between CSMA and CSMA/CD?
- ✓b) Why do we need "Byte Stuffing" in PPP?
- c) What was main motive behind development of Asynchronous Transfer Mode?
- d) Why ATM networks are good in terms of predictability?
- ✓e) We know that Ethernet is "connectionless". What does that mean?
- ✓f) What advantage do we get with 2-dimensional parity compared to 1-dimensional parity?
- g) Why do we need MAC protocols?
- ✓h) Provide one main difference between Channel Partitioning Protocols and Random Access Protocols.
- ✓i) Give one main difference between "Polling" and "Token Passing" protocols.
- ✓j) Why do we need a MAC address?

① a) CSMA/CD is detecting the collision's short amount of time and it deals with collisions so if collision's occurs it will determine which node will stop and which node will complete transmission. But CSMA not deals with collisions, if collision's occurs then both nodes will stop. (2)

② b) PPP frame may have information that have the same pattern of the flag (01111110) so the receiver side will not know if this is an end flag (end of frame) or beginning of the frame or a data!! (2) by Byte Stuffing if the receiver sees two flag pattern are coming after the other (01111110 01111110) then it will know that there's a data.

③ c) ~~If the receiving side make a check for the frame (error checking) then it will not~~ there is no handshaking before transmitting the data the sender will transmit the data immediately which makes it fast. (2)

④ d) by 2-dimensional parity we can correct the error not only detect it (not always, unless there are no errors two errors in the same row or same column). in 1 dimensional parity we only detect the error. (2)

5) ④ In channel partitioning protocols there will not be any collision and each node will transmit at fixed amount of rate. In Random access protocols there will be a lot of collisions but each node will transmit at a full rate. ②

6) ① In polling protocols there is a master that will give the priority to transmit to one node, but in token passing protocol there is no master but only a frame (token) that will be in one node and the node itself will give it to another node. ②

7) ① The MAC address is unique for each adapter (computer), so you will never see two computers having the same MAC address which will help the switch to know the receiver. ②

③ It supports audio and video and all technologies at that time, such as Ethernet do not support them.

d) Fixed size of cells we can know the time to deliver each cell

⑧ If we have multiple users to share the same link the MAC protocols will organize between them.